Developing Video-Based Learning Media with Problem-Based Learning Approach on Pythagorean Theorem Topic

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Article History:
Received: Sept 30, 2022
Revised: Oct 19, 2022
Accepted: Oct 27, 2022
Online First: Nov 07, 2022

Keywords:
Learning Video, Problem-Based Learning, Pythagorean Theorem

Kata Kunci:
Video pembelajaran, Pembelajaran berbasis masalah, teorema Pythagoras

How to cite:
Shofiyyah, W., & Qohar, A. (2022). Developing Video-Based Learning Media with Problem-Based Learning Approach on Pythagorean Theorem Topic. *Edunesia: Jurnal Ilmiah Pendidikan, 3* (3): 252-272.

Abstract: Technology and information development give significant changes to the required human skills in the current era. Educational development is also needed so it can prepare people to fulfill nowadays standards, one of which was through the development of learning media that can set up students so they have the opportunity to develop the abilities needed. The goal of this study is to develop a mathematics learning video based on a problem-based learning approach to the Pythagorean Theorem topic. This is a Research and Development (R&D) study with the ADDIE development method. This study's subjects were 17 eighth-grade students at Junior High School 2 Pandaan. The results show that the problem-based mathematics learning video on the Pythagorean Theorem topic had been successfully developed. Product validation by the media expert got a score of 3.71 and product validation by the material expert got a score of 3.70 which means that the product is valid. Then for the product, practical tests got a score of 3,34 which means that the product is practical. The result of the effectiveness test from the student's score on the evaluation test after learning using the media shows that 82.4% of all subjects have reached the Minimum Mastery Criteria (KKM) so the product can be said to be effective. The results indicate that problem-based learning videos can be used as learning media on the Pythagorean Theorem topic.

Abstrak: Perkembangan teknologi dan informasi memberikan perubahan yang signifikan terhadap keterampilan manusia yang dibutuhkan di era saat ini. Pengembangan pendidikan juga diperlukan agar mampu mempersiapkan masyarakat untuk memenuhi standar saat ini, salah satunya melalui pengembangan media pembelajaran yang mampu menyiapkan siswa agar mereka memiliki kesempatan untuk mengembangkan kemampuan yang dibutuhkan. Penelitian ini bertujuan untuk mengembangkan video pembelajaran matematika berbasis pendekatan Problem-Based Learning pada topik Teorema Pythagoras. Penelitian ini merupakan penelitian Pengembangan dengan metode pengembangan ADDIE. Subjek penelitian ini adalah 17 siswa kelas VIII SMP Negeri 2 Pandaan. Hasil penelitian menunjukkan bahwa video pembelajaran matematika berbasis masalah pada topik Teorema Pythagoras telah berhasil dikembangkan. Validasi produk oleh ahli media mendapat skor 3,71 dan validasi produk oleh ahli materi mendapat skor 3,70 yang berarti produk tersebut valid. Kemudian untuk uji praktik produk mendapatkan skor 3,34 yang berarti produk tersebut praktis. Hasil uji keefektifan dari nilai siswa pada tes evaluasi setelah pembelajaran menggunakan media menunjukkan bahwa 82,4% dari seluruh mata pelajaran telah mencapai Kriteria Ketuntasan Minimal (KKM) sehingga produk dapat dikatakan efektif. Hasil penelitian menunjukkan bahwa video pembelajaran berbasis masalah dapat digunakan sebagai media pembelajaran pada topik Teorema Pythagoras.

https://doi.org/10.51276/edu.v3i3.277

A. Introduction

Entering the 21st century, science and technology already further developed than in previous years. That thing can be shown by the increasing need for new skills that are suitable in this era (Lavi et al., 2021). Technology and information development also give significant changes to the required human skills in this current era (Puji & Umamah, 2018; Teo, 2019). Education is one of the most important things in human life because education is also a start or a trigger for human life development. Education is not the main aspect that can help people in solving any social problems, but education has an important role to change the future generation's mindset on facing a condition or problems in the future (Kovacs, 2017).

Education is also contributing to developing knowledge, skill, and attitude as well as any other values that prepare humans to contribute and be useful in an inclusive and sustainable future (OECD, 2018). To realize that, required educational development so that we could fulfill this era's challenge (Chalkiadaki, 2018). If the previous year's education is enough to teach about writing, reading, and arithmetic (3Rs), then it needs to be developed by blending with skills that are needed nowadays, that is communication, creation, critical thinking, and collaboration (4Cs) (Erdoğan, 2019).

Support the previous opinion, said that the 3Rs are known to be the core of any subject, and 4Cs have a role as a skill needed by the students to gain success in the future (Kivunja, 2015). The implementation of that thing in Indonesia was already been included in the Main Competencies in the 2013 curriculum, such as mathematics subjects that not only give knowledge and counting skill but are also expected to train the student's reasoning and analytical skills for solving problems.

That thing goes along with the standards of the mathematical learning process according to The National Council of Teaching Mathematics, that is communication, representation, reasoning, proof, and also problem-solving (Hera & Sari, 2015). To achieve a learning process that can facilitate students to develop those skills, needed various components that support reaching that goal. Needs an approach that capable of conditioning students to get a chance to develop the skills mentioned before, some approaches or methods that suitable are Contextual Teaching Learning (CTL), Realistic Mathematics Education (RME), and Problem-Based Learning (PBL). Through some of that approach, students expected to be able to connect the knowledge they got before to solve contextual problems that is given, so the students could start practicing and motivated to connect among given material and daily life situation (Pinwanna, 2015).

Among the methods and approaches that already mentioned before, there are some advantages from Problem-Based Learning approach, that increasing student's activity on learning to find new knowledge related to the topic that will be learned also practiced to connect that knowledge with daily life, besides that through problem-solving students also could get a better understanding of the learned material (Lestaringsih, 2017). However, it's not a new thing that many students in Indonesia define mathematics as one difficult subject (Qohar et al., 2021). Especially in pandemic period, when students spend less time to study

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than before pandemic, students might not study properly and lost motivation to study (Haser et al., 2022).

Apart from students themselves, motivation could be stimulated from learning environment which teachers have an important role to build supportive learning environment. That could be done with developing learning strategy that used include the learning method and media (Puspitarini & Hanif, 2019). Learning innovation also needed to help students face difficulty in learning mathematics (Qohar et al., 2021).

Students also experienced difficulties when studying Pythagorean Theorem. Based on (Rudi et al., 2020) research result, students face difficulty in understanding Pythagorean Theorem concept. Besides that, through observation result in the subject before research, found that students face difficulty to convert contextual problems into a mathematical model correctly. To help primary and middle school students to overcome the difficulty in learning mathematics, those are plenty effort that already done such as using technology advances nowadays, there are so many new digital innovations developed to help either in explaining or in understanding mathematical concept (Benavides-Varela et al., 2020; Wijaya et al., 2021).

Among the technology innovation that possible to be applied to learning activity, sometime teachers also still facing difficulty to adjust applied technology pedagogically (Buentello-Montoya et al., 2021). However, pandemic condition indirectly forces to use technology as much as possible on any occasion, either students or teachers forced to adapt quickly to this state so the learning process can continue

Nowadays, learning process is done with a blended system between distanced learning and limited face-to-face learning, that caused the students divided into two sessions with alternating schedule everyday. On limited face-to-face learning, learning media usage hasn't been the main focus. Meanwhile, on distanced learning, learning media usage still need to be optimized so that students that learning in school or in the house get an equivalent learning experience.

(Hasiru et al., 2021) did an investigation related to learning media effectiveness that can be used on distanced learning there are learning video, Learning Management System Google Classroom, video conference Zoom, and chat app WhatsApp. Identification result shows that learning media Google Classroom and learning video proved effective while used in learning mathematics online or distanced.

Beside that, junior high school student's cognitive development still in a transition between concrete level to semi-concrete level, so required learning media selection that suitable with that developmental level (Widodo, 2018). Semi concrete learning media could be a two dimensional prop or graphic media that can be used to deliver the message and information visually (Sri et al., 2014).

Through observation and interview that have done to one of the mathematics teacher in the research school, known while on distanced learning school already used google classroom platform. However, related to material delivery to students in google classroom,

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the teacher only sent power point or pdf files, so that students that did distanced learning experienced meaningless learning.

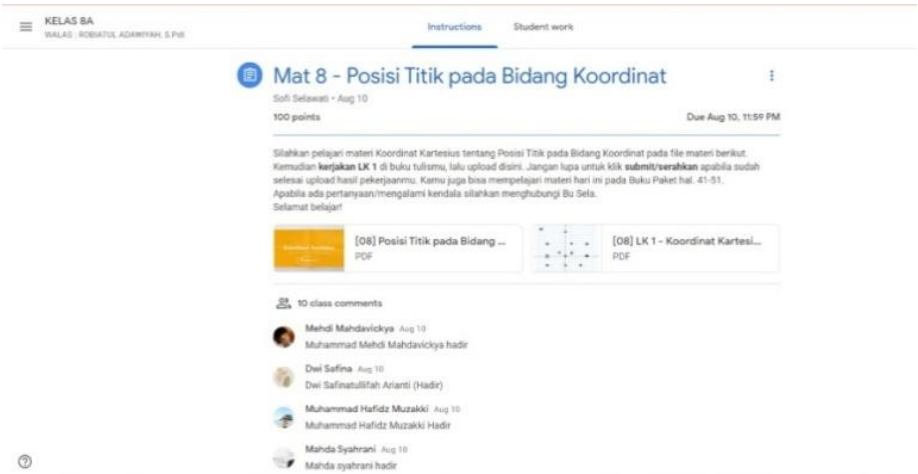

Figure 1. Material that given by the teacher through Google Classroom

Figure 2. Material that given by the teacher through Google Classroom

Support the identification result that already did by (Hasiru et al., 2021), proved that learning activity while using video could create new atmosphere, make learning activity more effective and efficient, then could increase student's ability and learning achievement, also said that compared to text or still image students more interested to study with learning video (Fadhli, 2015; Hermita et al., 2021; Mudasih & Subroto, 2019). Also, learning video usage is familiar to students and teacher, especially on distanced learning implementation nowadays. However, there is weakness on learning video usage.

(Munir, 2012) mentioned one of the weaknesses while using learning video usage is the easiness of material presentation that given, students less motivated to interact actively with the material presented on the video. That problem could be overcome by using the learning approach that could push students to be more active while using learning video.

Therefore, based on the explained background before, the goal of this study is to develop a mathematics learning video based on Problem-Based Learning approach on the Pythagorean Theorem topic.

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B. Method

This is a Research and Development (R&D) study that used ADDIE (Analysis, Design, Development, Implementation, Evaluation) (Aldoobie, 2015) development model. The first step was analysis, the researcher analyzed anything needed to solve chosen problem with the product that will be developed. Analytical activities include analyzing curriculum and learning goals. After analyzing things, next step was design step or planning that done to plan material for learning media that will be developed. Planning included choosing learning form, learning strategy, and planning the instrument's framework.

After the product was stated by the expert as a proper media, in the implementation step will be done a test to the research's subject, then will be done an evaluation of the product by the students and its effectiveness and practicality will be evaluated. Based on the test result also the comments and suggestion at the validation and testing step, the product will be perfect again. This research subjects are educational expert, learning media expert, and junior high school students. Educational expert and learning media expert are a mathematical education lecturer, and the students are from Junior High School 2 Pandaan. As many as 17 students from eighth grade was participated in the product testing. Students were randomly chosen with their teacher recommendation. Data collecting on this research use validation form, student response form, and evaluation test.

Validation form was used to measure the validity of the instruments that will be used. The validation form consists of product, student's worksheets, evaluation test, student response form, and lesson plan validation form. Product validation form for the learning video consists a form for material expert and a form for media expert. The material expert validation form consists of three evaluation aspects there are material suitability with learning set, material quality, also language and typography. The media expert validation form consists of six evaluation aspects there are functions and benefit, visual, audio, typography, language, and programming. Students worksheet validation form consists of five evaluation aspects there are a completeness of the contents, the accuracy of the presentation, worksheet's characterization, language, and appearance.

Then, the evaluation test validation form consists of three evaluation aspects there are language, material, and cognitive. Student response validation form consists of three evaluation aspects there are students feeling while using learning media, student's opinion about learning media aspects, and students opinion about learning video that used. The lesson plan validation form consists of four evaluation aspects there are identity and competencies completeness; learning method, material, media and learning source; learning activity steps; and learning result evaluation. Each validation form consists two parts, which the first part was a checklist with four stages Likert scale, as 1) not suitable 2) less suitable 3) suitable 4) very suitable. The second part of the validation form contains comments or suggestions from validator to the related instrument. Validity scores on each research instruments counted by the average score that given by the validator, then compared to this interval.

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Table 1. Validity Level

Validity Scores Average (Va)	Validity Level	Conclusion
$Va = 4$	Very Valid	No revision needed, could be used for testing
$3 \leq Va < 4$	Valid	No revision needed, could be used for testing
$2 \leq Va < 3$	Less Valid	Do revision, then validate again
$1 \leq Va < 2$	Invalid	Major revision, then validate again

Then, student response forms used for evaluating the practicality of the developed media. The form consists of ten questions that divided into three aspects, there are students feeling while using learning media, student's opinion about the learning media aspects, and students opinion about learning video that already used.

Student response form also consists of two parts which the first part was a checklist with four stages Likert scale, as 1) not agree 2) less agrees 3) agree 4) very agree. The second part of the validation form contains comments or suggestions from students to the learning media. Practicality score counted by the average score that given by the students, then compared to this interval.

Table 2. Practical Level

Practical Scores Average (Pr)	Practical Level	Conclusion
$Pr = 4$	Very Practical	No revision needed, no need to re-test
$3 \leq Pr < 4$	Practical	No revision needed, no need to re-test
$2 \leq Pr < 3$	Less Practical	Minor revision, then re-test again
$1 \leq Pr < 2$	Impractical	Total revision, then re-test again

The evaluation test used to evaluate the effectiveness of the learning media usage. The test done after the students learned while using the developed media. The test consist of two questions that represent each of the used indicators. Data collected as students score, then the media stated to be effective if at least 80% of the subjects could reach Minimum Mastery Criteria that is 78.

C. Result and Discussion

Result

Development was done with the ADDIE development model. The results from each development stage are explained below. After analyzing step was done, researcher decided to develop a product for Pythagorean Theorem material at eighth grade. The learning process for that material could be divided into three meetings. Based on learning goals analysis, researcher decided to develop learning media for the first meeting and set the goals for the planned study was students could find and prove Pythagorean Theorem and its usage to find out a right triangle's side length.

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On the design step, researcher planned material presentation for the media that will be developed and learning strategy selection that will be used. The results of this step were lesson plan as a guide at the product testing step, and learning video storyboard showed on the table below.

Table 3. Problem-Based Learning Video Storyboard

No	Steps	Description	Duration
1	Opening	Material delivery that will be shown on the video	20 s
2	Problem presentation	The problem presented	40 s
3	Students organizing to learning	Ask the students about their knowledge related to the given problem	20 s
4	Exploring guidance	Pythagorean Theorem Introduction	40 s
		Explain step-by-step instruction about finding Pythagorean Theorem (with student's worksheet)	150 s
5	Pause screen	Show paused screen as the students do the worksheet	10 s
6	Help students to develop and present	Re-emphasize the points that must be explained by the students	15 s
7	Closing	Video closing for evaluation guided by the teacher	10 s

On the development step, Problem-Based Learning video and other research instruments was developed. The product was created using Powtoon and Kinemaster based on the storyboard that done before. The product usage was accompanied with student worksheet that developed in three types based on three different combined polygons that used to get Pythagorean Theorem formula. After the product and the instruments already developed, then it will be validated by the validator.

Figure 3. The video opening

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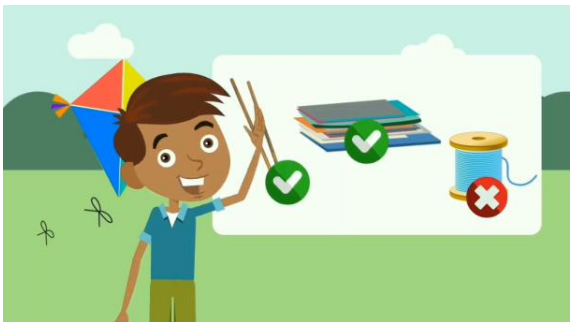

Figure 4. Problem presentation

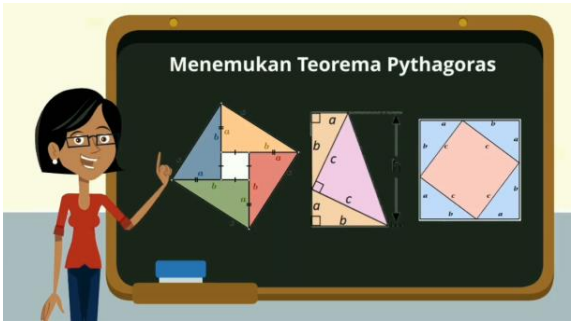

Figure 5. Finding Pythagorean Theorem

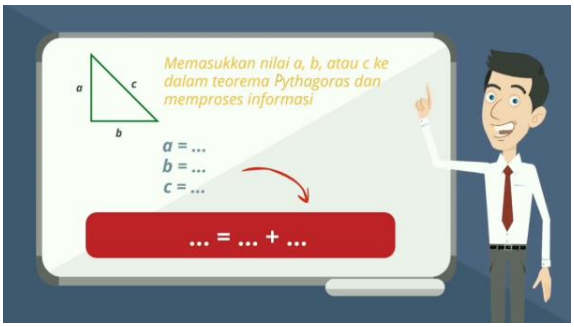

Figure 6. Pythagorean Theorem usage

Validity Test Result

Data collected from this research was analyzed by the steps explained before. The validity test results on each research instrument showed on the tables below.

Table 4. Video Validity Test Results by Media Expert

No	Indicators	V_1
1	Ease message or the taught material delivery to the students	3
2	Increase student's interest and motivation on learning mathematics	4
3	Build students creativity	3

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4	Colors, backgrounds, pictures, and animation blends are interesting	4
5	The pictures that used in the video are clear	4
6	Picture movements could be easily caught by the students (not too fast or too slow)	4
7	Not contained negative pictures or animations	4
8	The narrator's rhythm of the voice is caught well by the audience	3
9	The narrator's voice informative and clearly heard	4
10	Background music suitable with the atmosphere and didn't disturb the information delivery	4
11	The text's font easy to read	4
12	Text size is suitable (not too big or too small)	4
13	The language that used are easy to understand by students	4
14	Duration is enough for overall material presentation	3
Total Score ($\sum_{i=1}^{n} I_i$)		52
Comments/Suggestions: • Please edit the narration in the video so it's a bit slower		

From the scoring table, Problem-Based Learning video's validity test result of the media expert got total score 52. Then, count V_a average validation score as shown below.

$$V_a = \frac{\sum_{i=1}^{n} I_i}{n} = \frac{52}{14} = 3{,}71$$

Based on the validity criteria that shown before, media aspect of the Problem-Based Learning video included in the valid criteria without revision. However, to perfecting the product before the product testing, researcher have done revision based on the comments and suggestion given by the validator.

Table 5. Video Validity Test Results by the Material Expert

No	Indicators	V_1
1	The material suitable with the destined basic indicators	3
2	Material presentation suitable with Problem-Based Learning method	4
3	Problem and materials presented on the video are correctly explained	4

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4	Material served coherently	3
5	Difficulty level suitable to students characteristic	4
6	Terms and symbols usage are correct	3
7	Generally, this video's quality is suitable to be used in the student learning activity	4
8	The language that used are easy to understand by students	4
9	Writings are easy to read by the students	4
10	No mathematical symbol and expression mistakes	4
	Total Score ($\sum_{i=1}^{n} I_i$)	37
Comments/Suggestions • Triangle types • Add a concept about the base and the height of the triangle		

From the scoring table, Problem-Based Learning video's validity test result of the material expert got total score 37. Then, count V_a average validation score as shown below.

$$V_a = \frac{\sum_{i=1}^{n} I_i}{n} = \frac{37}{10} = 3{,}70$$

Based on the validity criteria that shown before, material aspect of the Problem-Based Learning video included in the valid criteria without revision. However, to perfecting the product before the product testing, researcher have done revision based on the comments and suggestion given by the validator.

Table 6. Student Worksheet Validity Test Result

No	**Indicators**	V_1
1	Student worksheet contains basic competency, indicators, guide, and the student's identity	3
2	Material served on the worksheet are true and correct	4
3	Material presentation suitable with the included learning goals	3
4	Symbols and terms used on the worksheet are correct	3
5	Worksheet order is suitable with material order that will be learned	3
6	Activity on the worksheet guide students to find the concept themselves and solve the problem	4

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7	The language used is effective	4
8	Every step explanation is clear and easy to understand	4
9	The information, commands, and questions used are clear and easy to understand	4
10	Writings, symbols, and pictures on the worksheet clearly read	3
11	Illustration and pictures used are suitable to the material	4
12	Worksheet's design is interesting	4
Total Score ($\sum_{i=1}^{n} I_i$)		43
Comments/Suggestions -		

From the scoring table, students worksheet's validity test result got total score 43. Then, count V_a average validation score as shown below.

$$V_a = \frac{\sum_{i=1}^{n} I_i}{n} = \frac{43}{12} = 3{,}58$$

Based on the validity criteria that shown before, student worksheet included in the valid criteria without revision.

Table 7. Lesson Plan Validity Test Results

No	Indicators	V_1
1	Contains school's identity, the subject's identity, class/semester, core material, time allocation	4
2	Indicators of competency achievement suitable with the basic competencies	3
3	Learning goals are clear and suitable with the basic competencies	3
4	Used learning method that suitable with the learning goals	4
5	The materials are suitable to the learning goals, coherent, and systematic	3
6	Learning source is easy to access by all of the students	4
7	Learning media and learning source that chosen are suitable for the Pythagorean Theorem topic	4
8	Learning steps are based on Problem-Based Learning steps (Problem orientation, Organizing students to learn, Guiding students to explore, Helping students to develop and present, Analyze and evaluate the problem-solving process)	4

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9	Learning steps demands students to actively involved in the learning process	4
10	Giving opportunity to the students for make material conclusion	4
11	Time allocation is suitable	4
12	Assessment procedure clarity	3
13	Instrument completeness	4
Total Score ($\sum_{i=1}^{n} I_i$)		48
Comments/Suggestions -		

From the scoring table, the lesson plan's validity test result got total score 48. Then, count V_a average validation score as shown below.

$$V_a = \frac{\sum_{i=1}^{n} I_i}{n} = \frac{48}{13} = 3{,}69$$

Based on the validity criteria that shown before, lesson plan included in the valid criteria without revision.

Table 8. Student Response Form Validity Test Results

No	Indicators	V_1
1	Mentioned indicator of the form could show the student's interest while learning using Problem-Based Learning video than using textbook or teacher's explanation only	4
2	Mentioned indicator of the form could show the student's opinion about Problem-Based Learning video's visual aspect	3
3	Mentioned indicator of the form could show the student's opinion about Problem-Based Learning video's audio aspect	4
4	Mentioned indicator of the form could show the student's opinion about no writing or picture mistakes so doesn't make any misunderstanding	3
5	Mentioned indicator of the form could show the student's opinion about access and usage easiness of Problem-Based Learning video	4
6	Mentioned indicator of the form could show the student's opinion about the information's clear explanation of the Problem-Based Learning video	4
7	Mentioned indicator of the form could show the student's opinion about their ease while understanding the material through Problem-Based Learning video	3
8	Mentioned indicator of the form could show the student's opinion about their interest on learning using Problem-Based Learning video	4
9	Mentioned indicator of the form could show the student's opinion about their motivation on learning using Problem-Based Learning video	4

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10	Mentioned indicator of the form could show the student's opinion about their problem-solving skill while learning using Problem-Based Learning video	3
Total Score ($\sum_{i=1}^{n} I_i$)		36
Comments/Suggestions -		

From the scoring table, students response forms validity test result got total score 36. Then, count V_a average validation score as shown below.

$$V_a = \frac{\sum_{i=1}^{n} I_i}{n} = \frac{36}{10} = 3{,}60$$

Based on the validity criteria that shown before, the student's response form included in the valid criteria without revision.

Table 9. Evaluation Test Validity Test Results

No	Indicators	V_1
1	According to Indonesian language rules, the sentences used are good and correct	4
2	The sentences used are easy to understand by the students	4
3	The sentences used aren't cause double interpretation	4
4	Question items suitable with the indicators	3
5	Material contents are according to what is taught	4
6	The evaluation test guide is clear	4
7	Time allocation suitable with questions difficulty	4
8	Scoring guide is clear	4
Total Score ($\sum_{i=1}^{n} I_i$)		31
Comments/Suggestions -		

From the scoring table, the evaluation test's validity test result got total score 31. Then, count V_a average validation score as shown below.

$$V_a = \frac{\sum_{i=1}^{n} I_i}{n} = \frac{31}{8}$$

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$= 3{,}87$

Based on the validity criteria that shown before, evaluation test included in the valid criteria without revision. From the overall validity test result, can be concluded that product and all instruments are valid.

Practicality Test Result

The practicality test result was obtained from the questionnaire answer by the students, and the result was shown below.

Table 10. Learning Media Practicality Test Result

No	Indicators	Average Score
1	I am more interested while learning using Problem-Based Learning video than using textbook or teacher's explanation only	3,18
2	Visualization of Problem-Based Learning video is interesting and clear	3,59
3	Audio on Problem-Based Learning video is interesting and clear	3,35
4	No writing or picture mistakes so doesn't make any misunderstanding	3,53
5	Problem-Based Learning video was easy to access and easy to use	3,47
6	Explanation about the finding Pythagorean Theorem process are clearer when using Problem-Based Learning video	3,41
7	The Pythagorean Theorem topic was easier to understand and remember while using Problem-Based Learning video	3,24
8	Problem-Based Learning video usage increase my interest to learn	3,18
9	I am more motivated to look for information about the learned material while learning mathematics using Problem-Based Learning video	3,12
10	I could increase my problem-solving skill while learning mathematics using Problem-Based Learning video	3,29
	Average	**3, 34**

Based on the practicality criteria that shown before, video based learning media with Problem-Based Learning approach on Pythagorean Theorem included in the practical criteria without doing the re-test.

Effectiveness Test Result

The effectiveness test results were from the student's evaluation test score, here is the student's score compared with Minimum Mastery Criteria (KKM) score 78.

Table 11. Student's Evaluation Test Results

Student's Number	Score	KKM	Description

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1	100	78	Passed
2	100	78	Passed
3	100	78	Passed
4	100	78	Passed
5	100	78	Passed
6	75	78	Not Passed
7	100	78	Passed
8	100	78	Passed
9	98	78	Passed
10	98	78	Passed
11	100	78	Passed
12	98	78	Passed
13	90	78	Passed
14	100	78	Passed
15	100	78	Passed
16	75	78	Not Passed
17	75	78	Not Passed

For learning completeness percentage counting from all of the subjects, as shown below.

$$\frac{Number\ of\ subjects\ that\ reach\ minimum\ score}{Number\ of\ all\ subjects} \times 100\% = \frac{14}{17} \times 100\% = 82{,}4\%$$

Effectiveness test results show that 82,4% subjects passed the minimum mastery criteria 78. Because of more than 80% subjects reach learning completeness, so Problem-Based Learning video for Pythagorean Theorem topic included in effective category.

Based on data analyzation from the validity test, the practical test, and the effectiveness test, overall, video-based learning media with Problem-Based Learning approach on Pythagorean Theorem was qualified for valid, practical, and effective criteria.

Discussion

The final product of this research is a video-based learning media with Problem-Based Learning (PBL) approach. According to learning video characteristic such as visual quality, cognitive aspects, voice tone, pace, length and video's elements (Giannakos et al.,

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2014) that developed was already validity tested. Based on the validity test result of the media expert, learning video that already developed was valid (Table 3).

Based on how it presented, the product show that it was suitable with the essential point of a learning media. Learning media definition itself according to (Puspitarini & Hanif, 2019) is a physical or non-physical tool that can help teachers to deliver the material effectively and efficiently. Then, based on validity test results by material expert with validity score 3,70 concluded that the content of the video was valid. Through the indicators (Table 4), the material presentation could be said that it's suitable with Problem-Based Learning method. Supported by Hung, Jonassen, and Liu opinions on (Aslan, 2021) that recommend to integrate PBL with the online learning environment with various media such as audio, video, and animation.

After the product and the instruments stated valid, the product was tested to 17 eighth grade students that never learned Theorema Pythagoras as the research subject. The learning process was done based on the lesson plan that's already arranged. The learning process was done in random small groups of students. After that, the researcher explains the learning process techniques Problem-Based Learning steps also the access to the learning media that will be used. Students seem to be enthusiastic to learn with video based learning media that's never been used before.

According to the storyboard, material presentation in the video follows Problem-Based Learning steps those are, orientating students to the problem, guiding students on the information exploration on the groups or individually, help students to develop their finding and results presentation, then analyze and evaluate the problem-solving process that done by the students (Sumartini, 2016).

The usage of the learning video was equipped with a worksheet to guide students in learning the concept of the Pythagorean Theorem through Problem-Based Learning approach, so that the arrangement of the worksheet also pay attention to the Problem-Based Learning characteristics and its steps. The worksheet arranged was also validity tested as valid criteria (Table 5). While in the learning process, students seem to be discussing actively to find information and do the worksheet. Some of the students in the groups seems need to repeat the learning video to find the information for the question in the worksheet.

Students not only got the knowledge about the Pythagorean Theorem's formula, but also the process of finding or prove Pythagorean Theorem using a combined area of some polygons. Based on the worksheet results, could be seen that the students could state the problems given and decide the steps to solve it until they got the final results. In the introduction, already said that one of the weaknesses of learning video media usage caused the students be less active to interact with the served material (Munir, 2012). However, while in the learning process using the Problem-Based Learning video, some of the students actively ask about things that they still didn't understand or things that confused them about the material.

While in the learning process, beside the connections between students and teacher, it's also needed to pay attention to the learning space that used, whether digitally or physically such as book, notes, and etc. That connection forms quality and values of the learning experience that received by the students (Giannakos et al., 2016). When the working time was ended, some of the group representation for each kind of worksheets present their results and then continued by the researcher to confirm and conclude the material that already presented by the students. With the different worksheets among the students, they

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could give and take many information that they find about the Pythagorean Theorem material.

Some of Problem-Based Learning characteristics such as student centered learning, authentic problem presentation, information searching independently, small group learning, also teacher's role as a facilitator (Ari & Katrancı, 2014; Lidinillah, 2013). According to those characteristics, Problem-Based Learning implementation of the learning media also could facilitate students to master any competencies whether on attitude, knowledge, and skills also could push students to solve a particular problem (Dita et al., 2021).

After confirming that students don't have any questions or problems that found on today's material then the students done the evaluation test as the effectiveness test for the product that is learning video media that already developed. So that the learning goals that already set hopefully could be achieved by using the learning media that developed (Abi Hamid et al., 2020). Through the effectiveness test, the product stated as effective. It means that the expected learning goals by developing this product on indicator find and prove the Pythagorean Theorem also use the Pythagorean Theorem to find a right triangle's side length was achieved. From the evaluation test results, some of the students still unable to explain the reason of the answer they got related to the learned context. However, overall, students could solve the problem about finding right triangle's side length using the Pythagorean Theorem if the other two sides length are given.

One of learning video usage advantage is could explain the process better (Rusman, 2012), students could understand material faster while learning (Lubis, 2017). So, teachers could focus more on giving examples or the application of the theorem. As using Problem-Based Learning video, students could practice their problem-solving skill (Amalia et al., 2017). At the end of the class, students were asked to fill the student response form for the product's practicality test when it used for learning. Through the practicality test, Problem-Based Learning video was stated as practical (Table 9). It shows that the video developed could ease and help students in learning.

The product was made on two dimensional animation form and developed using powtoon. With more interesting, dynamic, and interactive display, objects could be presented more detail and also help students to understand difficult subject, so it could attract student's attention on its usage (Apriansyah, 2020; Fitriyani, 2019). Final product video has duration 5 minutes 47 second long, and according to (Korkut et al., 2015), that was the ideal duration of the video that could attract and gives a positive impact for the students. This video could be accessed by the students independently from YouTube and Google Drive, it's ease students, whether they do offline learning or online learning to get equal access to the learning media. Students also could repeat and pause the video based on their needs and their learning pace (Rusman, 2012; Yoon et al., 2021).

D. Conclusion

The product of this research is video-based learning media with Problem-Based Learning approach on Pythagorean Theorem was successfully developed. The product and the instruments were already done the validity test by the experts. From the scale of 4, product validity of the media expert got score 3,71 and product validity of the material expert got score 3,70. Then the validity test result of student worksheet as the product companion got score 3,58. Overall, the product that tested reach valid category.

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From the product's practical test from the response form filling by the students as the research subject, from the scale of 4 it got score 3,34 and shows that the developed product included in practical category. Then from the effectiveness test result by the score of evaluation test after using the product for learning, 82,4% of all the subjects reach the minimum mastery criteria so the product stated as effective. Based on validity, practicality, and effectiveness tests, video-based learning media with Problem-Based Learning approach could be used as mathematics learning media on Pythagorean Theorem material.

However, on this research, the products developed was a two dimensional animated video and limited to Pythagorean Theorem learning for the first meeting only. So that, in the future research could be developed for another type of video that more support the learning activity and student's skill development also it could be developed for another Pythagorean Theorem meeting learning media or for other material.

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